/ **Marley MC** *Fluid Cooler* /

User Manual uk_07-1185C

SPX
COOLING TECHNOLOGIES

Contents

Note

This manual contains vital information for the proper installation and operation of your fluid cooler. Carefully read the manual before installation or operation of the fluid cooler and follow all instructions. Save this manual for future reference.

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The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

⚠ Warning

Indicates presence of a hazard which can cause severe personal injury, death or substantial property damage if ignored.

⚠ Caution

Indicates presence of a hazard which will or can cause personal injury or property damage if ignored.

Note

Indicates special instructions on installation, operation or maintenance which are important but not related to personal injury hazards.

Preparation

The Marley MC Fluid Cooler purchased for this installation represents the current state of the art in counterflow, forced draft fluid cooler design. Thermally and operationally, it is the most efficient fluid cooler of its class.

These instructions—as well as those offered separately on motors, fans, float valves, pumps, etc.—are intended to assure that the fluid cooler serves you properly for the maximum possible time. Since product warrantability may well depend upon your actions, please read these instructions thoroughly prior to operation.

If you have questions about the operation and/or maintenance of this product, and you don't find the answers in this manual, please contact your Marley sales representative. When writing for information, or when ordering parts, please mention product serial number shown on the nameplate located on the access door.

Safety First

The location and orientation of the fluid cooler can affect the safety of those responsible for installing, operating or maintaining the fluid cooler. However, since SPX Cooling Technologies does not determine the location or orientation of the fluid cooler, we cannot be responsible for addressing those safety issues that are affected by the fluid cooler's location or orientation.

⚠ Warning

The following safety issues should be considered by those responsible for designing the fluid cooler installation.

- ***access to and from maintenance access doors***
- ***the possible need for ladders (either portable or permanent) to gain access to the discharge level or maintenance access doors***
- ***the possible need for external access platforms***
- ***potential access problems due to obstructions surrounding the fluid cooler***
- ***lockout of mechanical equipment***
- ***the possible need for safety cages around ladders***
- ***the need to avoid exposing maintenance personnel to the potentially unsafe environment inside the fluid cooler***

Preparation

Note

Those are only some of the safety issues that may arise in the design process. SPX strongly recommends that you consult a safety engineer to be sure that all safety considerations have been addressed.

Several options are available that may assist you in addressing some of these personnel safety concerns, including:

- Distribution level access platform with handrail system around the perimeter of the platform with a ladder for access to the platform.
- Ladder extensions—used where the base of the tower is elevated.
- Safety cages for ladders.
- Access door platform guardrail system around the perimeter of the platform with a ladder for access to the platform.

Fluid Cooler Location

Space available around the fluid cooler should be as generous as possible to promote ease of maintenance—and to permit freedom of airflow into and through the fluid cooler. If you have questions about the adequacy of the available space and the intended configuration of the fluid cooler, please contact your Marley sales representative for guidance.

Prepare a stable, level support foundation for the fluid cooler, utilizing weight, wind load, and dimensional information appearing on appropriate Marley submittal drawings. Supports must be level to insure proper operation of the fluid cooler.

⚠ Warning

The fluid cooler must be located at such distance and direction to avoid the possibility of contaminated fluid cooler discharge air being drawn into building fresh air intake ducts. The purchaser should obtain the services of a Licensed Professional Engineer or Registered Architect to certify that the location of the fluid cooler is in compliance with applicable air pollution, fire and clean air codes.

Installation

Shipment

Unless otherwise specified, the MC Fluid Cooler ships by truck (on flat bed trailers), which lets you receive, hoist, and install the tower in one continuous operation. Single-cell coolers ship on one truck. Multicell fluid coolers, depending on their size, may require more than one truck.

Responsibility for the condition of the fluid cooler upon its arrival belongs to the trucker—as does the coordination of multiple shipments, if required.

Receiving Fluid Cooler

Prior to unloading the fluid cooler from the delivering carrier, inspect the shipment for evidence of damage in transit. If damage is apparent, note the freight bill accordingly. This will support your future recovery claim.

Find and remove the installation instruction drawings and bills of material located in a plastic bag in the collection basin. This information should be kept for future reference and maintenance purposes.

Hoisting Fluid Cooler

All MC Fluid Cooler models consist of two modules per cell. The upper module includes hoisting clips at the bottom corners. Hoisting clips on the lower module are attached to the top at the horizontal cross channels. A ***Hoisting-Installation*** label which has hoisting dimensional information is located on the side casing near the tower centerline. Remove fluid cooler modules from the carrier and hoist into place according to the instructions on the label.

⚠ Caution

MC Fluid Cooler upper and lower modules must be hoisted and set separately. Do not preassemble modules prior to hoisting.

⚠ Warning

Hoisting clips are provided for ease of unloading and positioning the fluid cooler. For overhead lifts or where additional safety is required, safety slings should also be placed under the fluid cooler modules. Under no circumstances should you combine the top and bottom modules of modular models and attempt to hoist them at the same time by utilizing the hoisting clips alone!

Installation

Fluid Cooler Installation

Note

These installation instructions are intended to help you prepare before your fluid cooler arrives. If discrepancies exist between these instructions and those shipped with the fluid cooler, the instructions shipped with the fluid cooler will govern.

1. Prior to placement of the fluid cooler, confirm that the supporting platform is level, and that the anchor bolt holes are correctly located in accordance with Marley drawings.
2. Place bottom module on your prepared supports, aligning anchor bolt holes with those in your supporting steel. Make sure that the orientation agrees with your intended piping arrangement. Attach fluid cooler to supporting steel with 13mm diameter bolts and flat washers (by others). See support drawing for location and quantity. Position flat washers between the bolt head and the fluid cooler basin flange.
3. Before setting top module in place on bottom module, clean any debris from the underside of the top module, skid and beams and from the top of the bottom module. Apply the mastic sealing strip supplied with the fluid cooler according to the ***MC Fluid Cooler Field Installation Drawing*** instructions. Place top module on the top peripheral bearing surface of bottom module, aligning mating holes as it is set in place. Attach top module to bottom module with fasteners provided according the ***MC Fluid Cooler Field Installation Drawing*** instructions.
4. Connect the recirculation piping with rubber coupling shipped with the bottom module piping according to drawings shipped with you fluid cooler.
5. Attach makeup water supply piping to appropriately-sized float valve connection located in collection water basin side wall. Install the drain and overflow according to the ***MC Fluid Cooler Field Installation Drawing*** instructions. If you wish to pipe overflow and drain water to a remote discharge point, make those connections at this time also.

Note

Fasteners and components provided by others that are to be attached to the tower must be compatible with the fluid cooler materials—i.e. fasteners in a stainless steel cold water basin must be stainless steel.

Installation

6. Attach process fluid supply and return piping to the coil. Standard field piping connection is an NPT male connection at the coil. A flanged connection requires a gasket between the fluid cooler and the fluid supply piping.

⚠ Caution

For welded connections protect adjacent areas from excessive heat and sparks or damage may occur.

7. Wire motor(s) and recirculation pump(s) in accordance with wiring diagram.

⚠ Warning

For maintenance/safety purposes, SPX Cooling Technologies recommends a lockout type disconnect switch for all mechanical equipment. In addition to a disconnect switch, the motor should be wired to main power supply through short circuit protection, and a magnetic starter with overload protection.

Motor Wiring

Wire motor leads as shown on the motor nameplate matching the supply voltage. Do not deviate from the motor nameplate wiring.

Either of following symbols may be shown on the motor nameplate – Δ, ΔΔ, Y, or YY. These symbols represent how the motor is constructed on the inside and in no way have anything to do with a Delta or Wye electrical distribution system serving the motor.

When using a starter:

- Set motor overload protection to 110% of motor nameplate amps. This setting allows the fan motor to operate during cooler weather. During cooler weather it is common for the motor to draw 6 to 10% higher than nameplate amps. High amps are common during tower commissioning when the tower is dry and the ambient air temperature is cool.
- Do not start the motor more than ***six*** times per hour. Short cycling the tower will cause fuses, breakers or O.L.s to operate and will decrease motor life.

Installation

When using a *two-speed* starter:

- Motor rotation must be the same at slow speed and high speed.
- Single winding motor requires a starter with a shorting contactor.
- Two-winding motor requires a starter without a shorting contactor.
- All two-speed starters must have a 20 second time delay relay when switching from high speed to low speed.
- Do not start the motor more than ***six*** times per hour (each low speed start and each high speed start count as one start).

When using a VFD:

Note

Before beginning, ensure that the motor is rated for "Inverter Duty" per NEMA MG-1, part 31.

- Set the VFD solid state overload protection to 119% of motor nameplate amps and set "maximum current parameter" in the VFD to motor nameplate amps. "Maximum current parameter" will reduce fan speed and limit amp draw to nameplate amps during cold weather operation. If furnished with a mechanical O.L. set this at 110% over motor nameplate amps.
- Motor rotation must be the same in both VFD mode and By-pass mode.
- If cable distance between the VFD and motor is greater than 31m a DV/DT output filter is recommended to avoid damage to the motor. 31m distance is based on our field experience, the VFD manufacture may state different distances and distance does vary depending on the VFD manufacture.
- Program the VFD for variable torque output. Flux vector and constant torque modes may damage the gearbox.
- Do not start and stop the motor using the safety switch at the motor. If the drive is being commanded to run and the load side is cycled ON and OFF with the safety switch this may damage the VFD.

Using a VFD in cooling applications has advantages over traditional single or two speed motor control. A VFD can reduce the cost of electrical energy being used and provide better temperature control. In addition, it reduces the mechanical and electrical stress on the motor and mechanical equipment. Electrical savings can be large during periods of low ambient temperature when the cooling requirement can be satisfied at reduced

speeds. To benefit from these advantages, it is important that the drive be installed correctly.

Marley supplies VFD and VFD controls specifically designed for our cooling products. If you have purchased a Marley VFD and/or controls package, please follow the instructions in the *User Manual* for that system. Most VFD problems can be avoided by purchasing the Marley drive system. If you are installing a VFD other than the Marley drive, please refer to that drives installation manual.

⚠ Warning

Improper use of a VFD may cause damage to equipment or personal injury. Failure to correctly install the VFD drive will automatically void all warranties associated with the motor and any equipment that is either electrically or mechanically (directly) attached to the VFD drive system. The length of this warranty avoidance will be contingent on properly installing the VFD system and repairing any damage that may have occurred during its operation. SPX Cooling Technologies does not assume responsibility for any technical support or damages for problems associate with non-Marley brand VFD systems.

⚠ Warning

Changing the operational fan speed from the factory settings could cause the fan to operate in an unstable region which may result in damage to the equipment and possible injury.

Installation

Mechanical Equipment:

⚠ Warning

Warranty is void if the fluid cooler is operated at speeds which cause damaging vibrations to the tower and associated equipment. When utilizing a variable frequency drive, the fluid cooler must be tested across the full range of speeds and checked against CTI guidelines for excessive vibration. Speed ranges not meeting these guidelines must be locked out in the VFD.

⚠ Warning

Always shut off electrical power to the fluid cooler fan motor prior to performing any maintenance on the fluid cooler. Any electrical switches should be locked out and tagged out to prevent others from turning the power back on.

1. Spin the fan manually and observe the action of the sheaves and belts to be sure that the motor is properly aligned with the fan sheave. See Belt Tensioning and Sheave Alignment on page 21.
2. Momentarily bump (energize) the motor(s) and observe rotation of the fan(s). The fan should rotate in a counterclockwise direction when viewed from the fan inlet side from the motor end. If rotation is backwards, shut off the fan and reverse two of the three primary leads supplying power to the motor.

⚠ Caution

If tower is equipped with a two-speed motor, check for proper rotation at both speeds. Check also to see that starter is equipped with a 20 second time delay which prevents direct switching from high speed to low speed.

3. Check the torque on the fan and motor sheave after 10 to 60 hours of operation. See Bushing Fastener Torque Values on page 21.

Operation

Fluid Cooler Start-Up

⚠ **Warning**

Among other sources, outbreaks of Legionnaires' Disease have reportedly been traced to cooling towers and fluid coolers. Maintenance and water treatment procedures that prevent amplification and dissemination of Legionella and other airborne bacteria should be formulated and implemented BEFORE systems are operated and continued regularly thereafter to avoid the risk of sickness or death.

Water System:

1. New installations should be cleaned and treated with biocides by a water treatment expert before startup.
2. Remove any and all accumulated debris from fluid cooler. Pay particular attention to inside areas of collection water basin, distribution water basins and drift eliminators. Make sure that redistribution pump suction screens are clear and properly installed.
3. Fill the water system to an approximate depth of 33cm in the depressed area of the collection water basin. This is the recommended operating water level. Adjust the float valve so that it is 75% open at that level. Continue filling the system until the water reaches a level approximately 4mm below the lip of the overflow.
4. Start your pump(s) and check for proper rotation as indicated by the arrow on the pump cover, observe system operation. A certain amount of "pump-down" of the basin water level will occur before water completes the circuit and begins to fall from the upper module. The amount of initial pump-down may be insufficient to cause the float valve to open. However, you can check its operation by pressing down on the operating lever to which the stem of the float valve is attached.

   Some trial and error adjustment of the float valve may be required to balance the makeup water with tower operation. Ideally, the float valve setting will be such that no water is wasted through the overflow at pump shutdown. However, the water level after pump start-up **must** be deep enough to assure positive pump suction.
5. Open the valve on the tower bleed line and adjust bleed to the recommended rate. See Water Treatment section on page 18.
6. Continue pump operation for about 15 minutes, after which it is recommended that the water system be drained, flushed and refilled.
7. While operating the recirculating water pump(s) and prior to operating

the fluid cooler fan, execute one of the two alternative biocidal treatment programs described in the following:

- Resume treatment with the biocide which had been used prior to shutdown. Utilize the services of the water treatment supplier. Maintain the maximum recommended biocide residual (for the specific biocide) for a sufficient period of time (residual and time will vary with the biocide) to bring the system under good biological control ***or***
- Treat the system with sodium hypochlorite to a level of 4 to 5 mg/L (ppm) free chlorine residual at a pH of 7.0 to 7.6. The chlorine residual must be held at 4 to 5 mg/L (ppm) for six hours, measurable with standard commercial water test kits.

If the fluid cooler has been in operation and then shut down for a duration of time and not drained, perform one of the two previous biocidal treatment programs directly to the fluid cooler storage vessel (collection basin, drain down tank, etc.) without circulating stagnant water over the fluid cooler or operating the fluid cooler fan.

After biocidal pretreatment has been successfully completed, cooling water may be circulated over the tower with the fan off.

When biocidal treatment has been maintained at a satisfactory level for at least six hours, the fan may be turned on and the system returned to service. Resume the standard water treatment program, including biocidal treatment.

Fluid Cooler Operation

General:

The cold process fluid temperature obtained from an operating fluid cooler will vary with the following influences:

1. **Heat load:** With the fan in full operation, if the heat load increases, the cold process fluid temperature will rise. If the heat load reduces, the cold process fluid temperature will reduce.

   Note that the number of degrees (“range”) through which the fluid cooler cools the process fluid is established by the system heat load and the amount of fluid being circulated, in accordance with the following formula—formula is only valid for 100% water as process fluid:

   The fluid cooler establishes only the cold process fluid temperature attainable under any operating circumstance.

$$\text{Range} - °C = \frac{\text{Heat Load (kilowatts)}}{\text{Liters/sec} \times 4.187}$$

2. **Air wet-bulb temperature:** Cold process fluid temperature will also vary with the wet-bulb temperature of the air entering the fluid cooler. Reduced wet-bulb temperatures will result in colder process fluid temperatures. However, the cold process fluid temperature will not vary to the same extent as the wet-bulb. For example, a 11°C reduction in wet-bulb may result in only a 8°C reduction in cold process fluid temperature.
3. **Fluid flow rate:** Increasing the process fluid flow rate (L/s) will cause a slight elevation in cold process fluid temperature, while reducing the fluid flow rate will cause the cold process fluid temperature to decrease slightly. However, at a given heat load (see formula on page 13), process fluid flow reductions also cause an increase in the incoming hot process fluid temperature and thermal range.

Note

Under no circumstances should the recirculation water pump(s) be cycled to control process fluid temperature. Doing so may result in excessive and premature scaling on the coil exterior surface. It is recommenced that while process fluid is being circulated through the coil the fluid cooler recirculation water system always be in operation.

4. **Air flow rate:** Reducing air flow through the fluid cooler causes the cold process fluid temperature to rise. This is the recommended method by which to control leaving process fluid temperature.

   If your fluid cooler is equipped with a single-speed motor, the motor may be shut off when the process fluid temperature becomes too cold. This will cause the process fluid temperature to rise. When the fluid temperature then becomes too warm for your process, the motor can be restarted.

When operating in this mode care must be taken not to exceed a total fan acceleration time of 30 seconds per hour.

⚠ Caution

Fan cycling limits: From a dead stop, determine the number of seconds it takes the fan to arrive at full speed. Divide this number into 30 to determine the allowable number of starts per hour. Considering the

normal fan and motor sizes utilized on MC Fluid Coolers, anticipate that approximately 4 to 5 starts per hour are allowable.

If your fluid cooler is equipped with a two-speed motor(s), you will enjoy greater opportunity for process temperature control. When the process fluid temperature becomes too cold, switching the fan to half-speed will cause the cold process fluid temperature to rise—stabilizing at a temperature a few degrees higher than before. With a further reduction in fluid temperature, the fan may be cycled alternately from half-speed to off—subject to the same constraint of 30 seconds of allowable acceleration time per hour as outlined above.

If your fluid cooler consists of two or more cells, cycling of motors may be shared between cells, increasing your steps of operation accordingly.

⚠ Caution

Multiple fan motors serving a single coil section must be cycled simultaneously. This applies to all 7055 and 7075 MC Fluid Cooler models.

Multicell fluid coolers equipped with two-speed motors will maximize energy savings and minimize sound levels if fans are staged so that all fans are brought up to low speed before any fan goes to high speed.

For greater insight on process fluid temperature control, please read **"Cooling Tower Energy and its Management"**, *Technical Report #H-001-A*, available at spxcooling.com.

Wintertime Operation:

Note

It is the operator's responsibility to prevent the formation of destructive (hard) ice on the fluid cooler coil. Certain guidelines should be followed:

1. Do not allow the fluid cooler's leaving process fluid temperature to drop below 8°C . If such low temperature operation is necessary or beneficial to your process, establish the minimum allowable level as follows:

   During the coldest days of the first winter of operation, observe whether any ice is forming on the air inlet, particularly near the bottom part of the louver face. If hard ice is present on the air inlet, you must increase the allowable cold water temperature.

Operation

⚠ **Caution**

If the minimum allowable cold process fluid temperature is established at or near minimum heat load, it should be safe for all operating conditions.

Having established the minimum allowable cold water temperature, maintaining that temperature can be accomplished by fan manipulation, as outlined in **Item 4** under **Fluid Cooler Operation**.

2. A fan operating in a forced-draft tower is subject to the risk of freezing. Icing is a particular danger as this can form not only on the fan blades, but also the inlet guard. Ice particles can be thrown off and cause severe damage. The fan casing should be checked so that any water entering it (either from the tower or external sources) can drain away. If water is allowed to collect in the fan casing, the fan could be frozen into place. This could result in damage to the drive system if starting were attempted.
3. As cold air enters the fluid cooler, it causes the falling water to be drawn inward. Thus, under fan operation, the lower periphery of the fluid cooler structure remains partly dry, seeing only random splashing from within the fluid cooler—plus normal atmospheric moisture from the entering air. Such lightly wetted areas are most subject to freezing.

   Although ice is unlikely to cause structural damage, it may build up sufficiently to restrict the free flow of air. This effectively reduce the fluid cooler's thermal performance efficiency. When excessive ice forms, stop the fan for a few minutes. With the fan off, the action of the spray system will cause a slight downward movement of air through the coil and deice the fluid cooler.

Intermittent Wintertime Operation:

If periods of shutdown (nights, weekends, etc.) occur during freezing weather, measures must be taken to prevent the water in the cold water basin—and all exposed pipework—from freezing. Several methods are used to combat this, including automatic basin heater systems and pump freeze protection systems available from Marley.

Operation

⚠ **Warning**

Basin heaters systems will not prevent the coil from freezing.

⚠ **Caution**

Unless some means of freeze prevention is incorporated into your system, the tower basin and exposed pipework should be drained at the beginning of each wintertime shutdown period.

⚠ **Warning**

If fluid cooler basin is drained, verify that all basin heaters have been shut off either by automatic cutoff or disconnect switch.

Protection Against Coil Freezing:

Ethylene and propylene glycol solutions are the best means to protect the coil from freezing. The following table provides the coil volume for each MC Fluid Cooler model. When the use of industrial antifreeze solutions is not possible, the system must be operated to meet both of the following conditions.

1. Maintain sufficient flow rate through the coil.
2. Maintain sufficient heat load on the process fluid. Fluid exiting the coil must be maintained at or above 8°C. Cycling of the recirculation pump should not be used to control process temperatures.

Model	Coil Volume liters	Model	Coil Volume liters
MCF7012_081	42	MCF7055_081	265
MCF7012_101	49	MCF7055_101	333
MCF7012_121	61	MCF7055_121	401
MCF7013_081	64	MCF7073_081	163
MCF7013_101	79	MCF7073_101	204
MCF7013_121	95	MCF7073_121	246
MCF7014_081	87	MCF7074_081	231
MCF7014_101	106	MCF7074_101	288
MCF7014_121	129	MCF7074_121	344
MCF7054_081	174	MCF7075_081	337
MCF7054_101	220	MCF7075_101	424
MCF7054_121	261	MCF7075_121	507

⚠ **Caution**

Draining the coil is not acceptable as a normal method of freeze protection—draining promotes corrosion inside the coil tubes. Draining is acceptable in an emergency if the coil is not protected by an antifreeze solution.

It is recommended that you discuss your freeze prevention options with your local Marley sales representative.

Operation

Water Treatment and Blowdown

Maintaining Water Quality:

The steel used in MC Fluid Cooler's has been galvanized with a heavy zinc coating averaging 2.0 mils in thickness. Other materials used (PVC drift eliminators, bearing, belts) are selected to offer maximum service life in a “normal” fluid cooler environment, defined as follows:

Recirculating water with a pH between 6.5 and 8; a chloride content (as NaCl) below 500 ppm; a sulfate content (SO4) below 250 ppm; total alkalinity (as $CaCO_3$) below 500 ppm; calcium hardness (as $CaCO_3$) above 50 ppm; no significant contamination with unusual chemicals or foreign substances; and adequate water treatment to minimize scaling.

- Startup Conditions: The water conditions during initial fluid cooler operation are crucial in preventing premature corrosion of galvanized steel (white rust). For at least the first eight weeks of operation, pH should be controlled between 6.5 and 8.0 with hardness and alkalinity levels between 100 and 300 ppm (expressed as $CaCO_3$).
- Chlorine (if used) shall be added intermittently, with a free residual not to exceed 1 ppm—maintained for short periods. Excessive chlorine levels may deteriorate sealants and other materials of construction.
- An atmosphere surrounding the tower no worse than “moderate industrial”, where rainfall and fog are no more than slightly acid, and they do not contain significant chlorides or hydrogen sulfide (H_2S).
- Many proprietary chemicals exist for control of scale, corrosion, and biological growth and should be used prudently. Also, combinations of chemicals may cause reactions which reduce treatment effectiveness, and certain chemicals such as surfactants, biodispersants and antifoams may increase drift rate.

Note

The structure and coil of your fluid cooler consists primarily of galvanized steel, therefore your water treatment program must be compatible with zinc. In working with your water treatment supplier, it is important that you recognize the potential effects on zinc of the specific treatment program you choose.

Operation

⚠ **Warning**

Fluid Cooler Cleaning:

Any evaporative-type fluid cooler must be thoroughly cleaned on a regular basis to minimize the growth of bacteria, including Legionella Pneumophila, to avoid the risk of sickness or death. Service personnel must wear proper personal protective equipment during decontamination. Do NOT attempt any service unless the fan motor is locked out.

Operators of evaporative cooling equipment, such as closed circuit fluid coolers, should follow maintenance programs which will reduce to an absolute minimum the opportunity for bacteriological contamination. Public Health Service officials have recommended that “good housekeeping” procedures be followed, such as: regular inspections for concentrations of dirt, scale, and algae; periodic flushing and cleaning; and the following of a complete water treatment program including biocidal treatment.

The visual inspection should take place at least once a week during the operating season. The periodic flushing and cleaning should be done before and after each cooling season, but in any event at least twice a year. The drift eliminators, easily accessible surfaces and the coil should be flushed by use of a moderate-pressure water nozzle, being careful not to cause physical damage. A reliable water treatment program should be installed and maintained. Filtration devices may be employed to reduce the suspended solids concentrations, thus increasing the effectiveness of the water treatment program. See Fluid Cooler Startup instructions on page 12.

Blowdown:

A fluid cooler cools water by continuously causing a portion of it to evaporate. Although the water lost by evaporation is replenished by the makeup system, it exits the tower as pure water—leaving behind its burden of dissolved solids to concentrate in the remaining water. Given no means of control, this increasing concentration of contaminants can reach a very high level.

In order to achieve water quality which is acceptable to the fluid cooler, the selected water treatment company must work from a relatively constant level of concentrations. This stabilization of contaminant concentrations is usually accomplished by blowdown, which is the constant discharge of a portion of the circulating water to waste. As a rule, acceptable levels on which to base a treatment schedule will be in the range of 2-4 con-

centrations. The following table shows the minimum amount of blowdown (percent of flow) required to maintain different concentrations with various cooling ranges*:

Cooling Range	Number of Concentrations						
	1.5X	2.0X	2.5X	3.0X	4.0X	5.0X	6.0X
3°C	.78	.38	.25	.18	.11	.08	.06
6°C	1.58	.78	.51	.38	.25	.18	.14
9°C	2.38	1.18	.78	.58	.38	.28	.22
11°C	3.18	1.58	1.05	.78	.51	.38	.30
14°C	3.98	1.98	1.32	.98	.64	.48	.38
Multipliers are based on drift of 0.02% of the circulating water rate.							

* Range = Difference between hot water temperature and cold water temperature.

EXAMPLE: EXAMPLE: 44.2 L/s circulating rate, 10°C cooling range. To maintain 4 concentrations, the required blowdown is 0.458% or .00458 times 44.2 L/s, which is 0.2 L/s.

If fluid cooler is operated at 4 concentrations, circulating water will contain four times as much dissolved solid as the makeup water, assuming none of the solids form scale or are otherwise removed from the system.

Note

When water treatment chemicals are added, they should not be introduced into the circulating water system via the water collection basin of the fluid cooler. Water velocities are lowest at that point, which results in inadequate mixing. An ideal location would be the distribution piping on the pressure side of the pump.

Maintenance

Belt Tensioning

The belts are adjusted by means of a hinged base with tensioning bolts accessible through the access panel/fan guards. Check tension frequently during the first 24-48 hours of run-in operation. To properly adjust the belt tension, position the fan motor so that moderate pressure on the belt midway between the sheaves will produce a ½" deflection. Overtensioning shortens belt and bearing life. Keep belts free from foreign material which may cause slipping. Never apply belt dressing as this will damage the belt and cause early failure. A Dodge® V-Belt Tension Tester is an alternate method for tensioning V-belts. Check with you local belt supplier.

Sheave Alignment

- The motor sheave is to be positioned as close as possible to the motor in order to minimize torque on the motor bushings.
- The motor and fan sheaves may have grooves that are not used. The bottom surface of the motor and fan sheaves must be aligned within 3mm of each other and level within ½° (3mm in 300mm) in order to not adversely affect belt and sheave life.
- Alignment can be achieved by placing a straight edge across the top of the sheaves making sure that it is level and measuring down to the bottom surface of both sheaves at four points.
- The belt is located in the inboard set of grooves closest to the bearing.

Bushing Fastener Torque Values

Bushing	Fastener	Torque N·m
SD	¼ - 20	8
SK	5/16 - 18	18
SF	⅜ - 16	30
E	½ - 13	48

Fluid Cooler Maintenance

Some maintenance procedures may require maintenance personnel to enter the fluid cooler.

⚠ Warning

The purchaser or owner is responsible for providing a safe method for entering or exiting the access door.

Maintenance

Included with this instruction packet are separate User Manuals on each major operating component of the tower, and it is recommended that you read them thoroughly. Where discrepancies may exist, the separate User Manuals will take precedence.

The following is recommended as a minimum routine of scheduled maintenance:

⚠ Warning

Always shut off electrical power to the tower fan motor prior to performing any inspections that may involve physical contact with the mechanical or electrical equipment in or on the tower. Lock out and tag out any electrical switches to prevent others from turning the power back on. Service personnel must wear proper personal protective clothing and equipment.

Weekly: Inspect for bacterial growth and general operation conditions. Bacterial growth should be reported to your water treatment expert for immediate attention.

Monthly (Weekly at start up): Observe, touch, and listen to the fluid cooler. Become accustomed to its normal appearance, sound, and level of vibration. Abnormal aspects relating to the rotating equipment should be considered reason to shut down the fluid cooler until the problem can be located and corrected. Observe operation of the motor and fan. Become familiar with the normal operating temperature of the motor(s), as well as the sight and sound of all components as a whole.

Inspect drift eliminators and basin trash screens and remove any debris or scale which may have accumulated. Replace any damaged or worn out components. Use of high-pressure water may damage the eliminator material.

Observe operation of the float valve. Depress the operating lever to make sure that the valve is operating freely. Inspect the suction screen for plugging. Remove any debris that may have accumulated.

Check for any buildup of silt on the floor of the collection basin. Mentally make note of the amount, if any, so future inspections will enable you to determine the rate at which it is forming.

Every 3 months: Lubricate fan shaft bearings. While rotating equipment by hand, grease the bearings until a bead forms around the seals—a maximum charge of 12 mL is recommended. Mobil SHC 460 grease is recommended.

Maintenance

Semi-Annually: Clean and disinfect fluid cooler with biocides. Systems with biofouling, high general bacterial counts, or positive cultures of legionella may require additional cleaning. Refer to **"Fluid Cooler Cleaning"** section—page 19. Consult your water treatment expert as to prudent biological evaluation testing.

Annually: Relubricate motor(s) according to the manufacturer's instructions.

Check the belt tension and condition.

Check to see that all bolts are tight in the fan and mechanical equipment region. Refer to Component User Manuals for torque values.

Inspect the fluid cooler thoroughly, making maximum use of instructions given in the separate user manuals. Check structural bolted connections and tighten as required. Make preventive maintenance repairs as necessary.

Seasonal Shutdown Instructions

When the system is to be shut down for an extended period of time, it is recommended that the recirculation water system be drained. Leave the basin drains open.

⚠ Caution

Draining the coil is not recommended—draining promotes corrosion inside the coil tubes. See protecting coil in Freezing weather on page 17.

During shutdown, clean the fluid cooler (see Warning, page 19) and make any necessary repairs. Eliminators and louvers are easily removed to gain access to the coil. Pay particular attention to mechanical equipment supports and sheaves or coupling (or drive shafts).

Following each year's shutdown and cleaning, inspect the fluid cooler's metal surfaces for evidence of the need to apply a protective coating. Do not misinterpret grime as a need to have the tower painted. If relatively bright metal can be exposed by cleaning, consider that the galvanizing has remained effective. Unless there is evidence of a generalized failure of the galvanizing, localized touch-up should be all that is required.

Note

To the extent that the galvanizing (zinc coating) still exists, paint will not adhere to it readily. Contact the manufacturer of the coating you intend to use for instructions.

Maintenance

Fluid cooler framework: Check structural bolted connections and tighten as required.

Fans: Check fan assembly bolting and tighten as required. Use torque values prescribed in the *Fan User Manual*.

Fans shaft bearings: Lubricate fan shaft bearings at close of each operating season—see page 22.

Electric motors: Clean and lubricate motor at close of each operating season (refer to motor manufacturer's recommendations.) Check motor anchor bolts and tighten as required.

⚠ **Caution**

Do not start motor before determining that there will be no interference with free rotation of the fan drive.

The motor(s) should be operated for three hours at least once a month. This serves to dry out windings and re-lubricate bearing surfaces. Refer to the Marley **"Electric Motor User Manual"** *Manual 92-1475* available at spxcooling.com.

At start of new operating season, make sure bearings are adequately lubricated before returning motor to service.

Prolonged Shutdown

If shutdown period is longer than seasonal, contact your Marley sales representative for additional information.

Maintenance

SPX Cooling Technologies Services

Our interest in your MC Fluid Cooler does not end with the sale. Having conceived, designed, and manufactured the most reliable and longest-lasting fluid cooler of its class, we want to make sure that you gain the maximum possible benefit from its purchase.

Therefore, the following services are available which are intended to: assure the maximum possible service life under your operating conditions; tailor the operating characteristics to your specific needs—and maintain consistently optimum thermal performance capability. Electronic copies are available for download at spxcooling.com.

Replacement parts: A complete stock of parts and components is maintained at one or more of the various Marley plants. In cases of emergency, they can normally be shipped within 24 hours—by air freight if necessary. However, you would obviously benefit from anticipating your need in advance, thus avoiding the cost of special handling.

Be sure to mention your fluid cooler serial number (from the fluid cooler nameplate) when ordering parts.

Periodic maintenance: You may wish to contract with SPX Cooling for regularly scheduled visits—for the purpose of inspecting and reporting your fluid cooler's condition—to make recommendations intended to prevent emergencies— and to perform maintenance considered outside the norm.

This service is not intended to replace the important function performed by your maintenance staff. Their attention assures the fluid coolers's routine operating performance, and is invaluable. However, we recognize that the unusual manner in which a fluid cooler performs its function—as well as the unique forces which act upon it—may be considerations which occasionally require the services of an expert technician.

Maintenance Schedule

Maintenance Service	Monthly	Semi-annually	Seasonal Startup or Annually
Inspect General Condition and Operation	x		x
Observe Operation of:			
Mechanical–motor, pump, fan and drive mechanism	x		x
Makeup valve (if equipped)	x		x
Inspect for unusual noise or vibration	x		x
Inspect and Clean:			
Air inlet	x		x
PVC drift eliminators	x		x
Distribution system and nozzles	x		x
Collection basin	x		x
Fan and pump motor exterior	x		x
Coil surface		x	
Check:			
Collection water basin level	x		x
Blowdown–adjust as required	x		x
Lube lines if equipped:			
Check for leaks in hoses or fittings	x	**R**	x
Belt drive:			
Fan shaft bearing lubrication (every 3 mo.)		every 3 months	every 3 months
Check and tighten support fasteners			x
Check shaft, sheave and belt alignment			x
Check belt tension and condition		x	x
Check sheave bushing fastener torque			x
Fan:			
Check fan assembly fasteners			x
Motor:			
Lubricate (grease as required)			**R**
Check mounting bolts for tightness			x
Operate at least	3 hours a month	3 hours a month	3 hours a month
Basin Heater (if equipped):			
Check for proper operation of temp/low water level sensor			x
Inspect/clean buildup of contaminant from sensor		x	x
Structure:			
Inspect/tighten all fasteners		x	x
Inspect and touch up all metal surfaces			x

R — Refer to Component User Manual

Note: It is recommended at least weekly, that the general operation and condition be observed. Pay attention to any changes in sound or vibration that may signify a need for closer inspection.

Additional Services

Increased load requirements: MC Fluid Coolers are designed so that cells of either equal or unequal capacity can be added in the future. This allows you to compensate for the load increases that normally occur with the replacement or addition of production equipment—and still retain continuity with respect to your fluid cooler system.

Fluid cooler rebuilding: SPX routinely rebuilds and upgrades fluid coolers and cooling towers of all materials and manufacture. If your product ever reaches the limit of its service life, we recommend that you investigate the cost of rebuilding before you routinely order a new replacement tower.

Each MC Fluid Cooler includes a document package containing general orientation drawings, and tower component manuals. These documents contain important information relating to safe installation and operation of the fluid cooler. Field installation is required for some optional accessories. A separate installation drawing or manual for each purchased option is included in the document package along with bills of material. If you have purchased an option and can't find the appropriate installation drawing, contact your local Marley sales representative before proceeding.

In addition to these specific documents, numerous technical reports are published by SPX including more detailed information on a variety of cooling tower and fluid cooler operation and service topics. Electronic copies are available for download from our website at spxcooling.com.

For complete parts and service assistance, contact the Marley sales representative in your area. If you need help locating your representative, please phone 44 (0) 1905 720 241 or check the internet at spxcooling.com.

Troubleshooting

Trouble	Cause	Remedy
Motor will not start	Power not available at motor terminals	Check power at starter. Correct any bad connections between the control apparatus and the motor.
		Check starter contacts and control circuit. Reset overloads, close contacts, reset tripped switches or replace failed control switches.
		If power is not on all leads at starter, make sure overload and short circuit devices are in proper condition
	Wrong connections	Check motor and control connections against wiring diagrams.
	Low voltage	Check nameplate voltage against power supply. Check voltage at motor terminals.
	Open circuit in motor winding	Check stator windings for open circuits.
	Motor or fan drive stuck	Disconnect motor from load and check motor and fan drive for cause of problem.
	Rotor defective	Look for broken bars or rings.
Unusual motor noise	Motor running single-phase	Check motor and attempt to start it. Motor will not start if single-phased. Check wiring, controls and motor.
	Motor leads connected incorrectly	Check motor connections against wiring diagram on motor.
	Bad bearings	Check lubrication. Replace bad bearings.
	Electrical unbalance	Check voltages and currents of all three lines. Correct if required.
	Air gap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance
	Cooling fan hitting end belt guard	Reinstall or replace fan.
Motor runs hot	Wrong voltage or unbalanced voltage	Check voltage and current of all three lines against nameplate values.
	Wrong motor RPM	Check nameplate against power supply. Check RPM of motor and drive ratio.
	Bearing overgreased	Remove bearing reliefs. Run motor up to speed to purge excessive grease.
	Wrong lubricant in bearings	Change to proper lubricant. See motor manufacturer's instructions.
	One phase open	Stop motor and attempt to start it. Motor will not stat if single-phased. Check wiring, controls and motor.
	Poor ventilation	Clean motor and check ventilation openings. Allow ample ventilation around motor.
	Winding fault	Check with ohmmeter.
	Bent motor shaft	Straighten or replace shaft.
	Insufficient grease	Remove plugs and regrease bearings.
	Too frequent starting or speed changes	Limit cumulative accelerations time to a total of 30 seconds/hour. Set on/off or speed change set points farther apart. Consider installing a Marley VFD drive for fine temperature control.
	Deterioration of grease or foreign material in grease	Flush bearings and relubricate.
	Bearings damaged	Replace bearings.
Motor does not come up to speed	Voltage too low at motor terminals because of line drop	Check transformer and setting of taps. Use higher voltage on transformer terminals or reduce loads. Increase wire size or reduce inertia.
	Broken rotor bars	Look for cracks near the rings. A new rotor may be required. Have motor service person check motor.
Wrong motor rotation	Wrong sequence of phases	Switch any two of the three motor leads.

Troubleshooting

Trouble	Cause	Remedy
Unusual fan drive vibration	Loose bolts and cap screws	Tighten all bolts and cap screws on all mechanical equipment and supports.
	Worn fan shaft bearings..	Check fan shaft endplay. Replace bearings as necessary.
	Unbalanced motor	Disconnect load and operate motor. If motor still vibrates, rebalance rotor.
Fan noise	Impeller rubbing inside of cylinder	Adjust fan impeller. Adjustment may need to be axial i.e. moving impeller along the shaft to centralize it between the cylinders or radial by repositioning bearing or bearings to get the impeller concentric within the inlets.
	Fan shaft bearing.	Grease bearings.
Belt squeal or chirping	Belt slipping	Adjust belt
Scale or foreign substance in circulating water system	Insufficient blowdown	See "Water Treatment" section of this manual.
	Water treatment deficiency	Consult competent water treating specialist. See "Water Treatment" section of this manual
Cold water temperature too warm. See "Fluid Cooler Operation."	Entering wet bulb temperature is above design	Check to see if local heat sources are affecting fluid cooler. See if surrounding structures are causing recirculation of tower discharge air. Discuss remedy with Marley representative.
	Design wet bulb temperature was too low.	May have to increase fluid cooler size. Discuss remedy with Marley representative
	Actual process load greater than design	May have to increase fluid cooler size. Discuss remedy with Marley representative
	Overpumping	Reduce water flow rate over fluid cooler to design conditions.
	Fluid cooler starved for air	Check motor current and voltage to be sure of correct contract horsepower. Clean eliminators. Check to see if nearby structures or enclosing walls are obstructing normal airflow to fluid cooler. Discuss remedy with Marley representative.
Excessive drift exiting fluid cooler	Faulty drift elimination	Check to see that eliminators are clean, free of debris and installed correctly. Replace damaged or worn out eliminators panels.
Water leaking from fan scroll	Water level in tower too high	Adjust water level to correct level.
	Multiple fan motors serving a single coil section not being cycled simultaneously	Ensure all fans are operating simultaneously and at the same speed

SPX

COOLING TECHNOLOGIES

SPX COOLING TECHNOLOGIES UK Ltd

GREGORY'S BANK | WORCESTER WR3 8AB, UNITED KINGDOM | 44 (0) 1905 720 200 | info.uk@spx.com | **spxcooling.com**

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